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EVALUATION OF TWO BLANK FIRING ATTACHMENTS FOR THE M2HB CALIBER .50 MACHINE GUN

JUNE 1976

BY

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ABSTRACT

Firing tests were conducted using an M2HB Caliber .50 Machine Gun equipped with blank firing attachments (BFA) fabricated at Ft. Benning and Ft. Carson. Two BFA of each design were tested. Both designs operate on the muzzle booster principle. Three lots of blank ammunition were tested and one lot of M33 ball ammunition was fired to provide a base line for comparison of weapon mechanism performance. All of the existing blank ammunition including those lots tested were loaded in 1943-44 or in 1953. Because of its age and the way it was packed and stored the performance of individual rounds has deteriorated and varies widely down to refusal to fire. Although the erratic ammunition performance prevented quantitative accuracy in evaluation of test results the data did provide a basis for engineering evaluation and the recommendation that a coordinated program of ammunition and BFA development be considered for early implementation.

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MUZZLE EROSION

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Firing tests were conducted using an M2HB Caliber .50 Machine Gun equipped with blank firing attachments (BFA) fabricated at Ft. Benning and Ft. Carson. Two BFA of each design were tested. Both designs operate on the muzzle booster principle. Three lots of blank ammunition were tested and one lot of M33 ball ammunition was fired to provide a base line for comparison of weapon mechanism performance. All of the existing blank ammunition including those lots tested were loaded in 1943-44 or in 1953. Because of its age and the way it was packed and stored the performance of individual rounds has

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deteriorated and varies widely down to refusal to fire. Although the erratic ammunition performance prevented quantitative accuracy in evaluation of test results the data did provide a basis for engineering evaluation and a recommendation that a coordinated program of ammunition and BFA development be considered for early implementation.

BACKGROUND

Currently, there is no widely available blank firing attachment (BFA) for the M2 Heavy Barrel Caliber .50 Machine Gun, nor for the M85 Caliber .50 Machine Gun. Neither is there a current caliber .50 round of blank ammunition. Existing blank ammunition is overage (1942-44 and 1953 manufacture) made from obsolete unavailable components and does not perform reliably nor consistantly. Thus there is no way to simulate the firing of caliber .50 Machine Guns in field training exercises and two of the primary anti-personnel/anti-light vehicle/anti-air weapons cannot be employed in tactical training.

Given the requirement to use the weapons in engagement simulation systems such a REALTRAIN and MILES, a suitable weapon emission simulation system (WESS) is urgently required to provide a signature from the position of the firing weapon. The BFA can serve as that WESS for the caliber .50 Machine Guns.

In response to this need for a WESS, BFA to be used on the M2HB Machine Gun were fabricated at Ft. Benning and Ft. Carson. Both of these BFA are based on the muzzle booster concept and differ primarily in attachment means and structural detail. These devices received considerable testing at APG(1) and Ft. Benning(2) leading the Project Manager for Training Devices (PM-TRADE) to become concerned that prolonged use of these BFA would result in permanent damage or accellerated wear to the weapon. Subsequently, PM-TRADE tasked SARRI-LS-C to evaluate the effect of these BFA on weapon life and recommend a program to develop a BFA and round of ammunition. This report summarizes the result of this evaluation.

(1) ENGINEER DESIGN TEST (SAFETY EVALUATION) OF TRAINING DEVICE, BLANK FIRING, ADAPTER FOR CALIBER .50 M2 MACHINE GUN, TECOM PROJECT NO 1-WE-B23-000-009, REPORT NO APG-MT-4729

(2) OPERATIONAL FEASIBILITY TEST OF CALIBER .50 BLANK FIRING ADAPTER, TRADOC PROJECT NO 8-WE-418-BFA-601, USAIB PROJECT NO 3472

OBJECTIVES

There are two objectives to this test program and evaluation:

1. Determine the nature and extent of physical damage or excessive wear to the M2 Heavy Barrel, Caliber .50 Machine Gun which may be expected through prolonged use of Blank Firing Attachments (BFA) similar to those fabricated at Ft. Benning and Ft. Carson.

2. Recommend a development program which will lead to a Weapon Emission Simulation System (WESS) using the M2HB and/or M85 Machine Gun(s) for field training exercises.

SCOPE OF PROGRAM

Four blank firing attachments, two of the Ft. Carson design and two of the Ft. Benning design, were selected for testing. Three lots of blank ammunition, LC-L-95903, LC-L-12035, and TW-L-18052 were used for test firing. M33 Ball Ammunition from Lot No. LC-L-1-116 was used to establish performance baseline values.

The tests were conducted using a single receiver modified to permit taking time-displacement (T-D) records of the bolt travel. Two sets of parts (bolt sets) consisting of one bolt assembly, one lock block, and one accelerator were assigned to each BFA design. One of these bolt sets was used during the firing for the T-D records and the other bolt set was used when conducting the endurance test. Time displacement records were taken at $0^{o}F$, ambient and at $125^{o}F$.

Following the completion of the time-displacement records the parts sets and blank firing attachments were replaced and an endurance test was conducted on each type of blank firing attachment.

Each endurance test was scheduled to consist of 9,900 rounds with periodic inspections of the bolt sets approximately every 300 rounds to detect the onset and extent of wear or failure. These inspections were alternated with one blank firing attachment and associated bolt set being inspected while the other blank firing attachment and bolt set underwent a 300 round firing cycle.

A single machine gun barrel was used throughout the series of time-displacement and endurance tests until 13,261 rounds of blank ammunition had been fired through it. At that point muzzle errosion had progressed to the extent that the weapon would not cycle. The barrel and barrel extension were replaced to permit completion of the endurance test on the Ft. Carson blank firing attachment. The remaining 1,650 rounds were fired and upon inspection the muzzle cylinder was discovered to have developed a bulge.

Data taken from the time-displacement records was summarized and evaluated against weapon performance when firing M33 Ball Ammunition. Inspection reports on the bolt sets and periodic measurements made on the muzzle diameter were reviewed to detect wear or errosion trends.

All endurance testing was conducted on the premise that the basic performance of the blank firing attachment-ammunition combination would approximate as closely as possible weapon performance values obtained with M33 Ball ammunition. No attempt was made to deliberately overload either the weapon or the blank firing attachment.

Endurance testing using the Ft. Carson blank firing attachment was conducted with ammunition Lot No. LC-L-95903 since time-displacement records indicated this ammunition induced bolt energy in the order of 90 percent to 95 percent of the energy induced by M33 Ball Ammunition.

In the case of the Ft. Benning blank firing attachment only Lot No. TW-18052 would cycle the weapon in a reliable manner. Thus inspite of the fact that time-displacement records indicated induced bolt energy was over 20 percent in excess of that induced by M33 Ball Ammunition, the endurance test was attempted using TW-18052 ammunition for lack of an alternative. This test was terminated after 4,530 rounds because increasingly poor ignition performance of the available ammunition prevented continuity of weapon cycling and stressing and significant temperatures were not being achieved. In addition, unburned propellant in the weapon and surrounding it posed an increasing safety hazard.

SUMMARY OF RESULTS

The data as collected is far too voluminous to be included in this report. Instead, summaries germane to the immediate objectives are included which present the data in reduced form to facilitate the readers comprehension.

Section I is a concise summary of pertinent dynamic values for the combined mass of the barrel, barrel extension and bolt assembly before the bolt is unlocked from the barrel extension and also the pertinent dynamic values for the mass of the bolt assembly only following unlocking. The maximum kinetic energy of the unlocked bolt is then stated as a percentage of the maximum kinetic energy of the bolt as observed when firing the M33 round of ball ammunition.

Section II is a Table recording the problems encountered when firing the endurance test with references to the Appendix for substantiating data on component wear.

Section III is intended to provide insight into the transfer of barrel - barrel extension kinetic energy to the bolt assembly after unlocking. An energy transfer efficiency is calculated for the energy transfer. The observed trend of this efficiency to rise as initial velocity increases is believed to be due to added energy from increased residual pressures in the bore and muzzle cylinder rather than any change in the efficiency of the mechanical acceleration.

SUMMARY OF RESULTS

SECTION I

SUMMARY OF TIME-DISPLACEMENT RECORDS

ANALYSIS OF TIME-DISPLACEMENT RECORDS

Nomenclature

Symbol	Units	Description
V1	inch/second	Maximum Velocity of Barrel, Barrel Extension and Bolt Assembly before unlocking of the bolt during Recoil.
V2	inch/second	Maximum Velocity of Bolt in Recoil.
E1	lb-inch	Maximum Energy of Barrel, Barrel Extension and Bolt Assembly before unlocking of the bolt during Recoil.
E2	lb-inch	Maximum Energy of Bolt in Recoil.
$\overline{X}$		Mean of the distribution of Values.
σ		Standard Deviation of the distribution of values.

Table 1 Velocity/Energy Summary

BOLT SET NO. 1 FT CARSON BFA NO. 1A AMBIENT TEMPERATURE

		M33 Ball LC-L-1-116	T40 Blank LC-L-95903	% of M33	M1 Blank LC-L-12035	% of M33	M1 Blank TW 18052	% of M33
V1 Velocity	$\bar{X}$	110	100		105		122	
(Initial)	σ	4	3		5		6	
V2 Velocity	$\bar{X}$	209	200		212		249	
(Post Unlocked)	σ	15	9		16		16	
E1 Energy	$\bar{X}$	547	445		490		671	
(Initial)	σ	45	28		53		62	
E2 Energy	$\bar{X}$	255	234	92%	264	104%	363	142%
(Post Unlocked)	σ	38	22		40		49	
Firing Rate	$\bar{X}$	481	464		483		571	
TOTAL ROUNDS FIRED		25	30		25		24	
FAILURE TO REACH BUFFER		0	0		0		0	
FAILURE TO CYCLE		0	0		0		1	

Table 2 Velocity/Energy Summary

BOLT SET NO. 2 FT BENNING BFA NO. 2A AMBIENT TEMPERATURE

		M33 Ball LC-L-1-116	T40 Blank LC-L-95903	% of M33	M1 Blank LC-L-12035	% of M33	M1 Blank TW 18052	% of M33
V1 Velocity	$\bar{X}$	114	83		93		116	
(Initial)	σ	7	7		7		7	
V2 Velocity	$\bar{X}$	214	163		182		235	
(Post Unlocked)	σ	17	13		14		14	
E1 Energy	$\bar{X}$	583	312		394		609	
(Initial)	σ	73	56		56		71	
E2 Energy	$\bar{X}$	269	155	58%	195	72%	323	120%
(Post Unlocked)	σ	44	25		30		40	
Firing Rate	$\bar{X}$	493	391		400		520	
TOTAL ROUNDS FIRED		25	3		24		24	
FAILURE TO REACH BUFFER		0	2		4		0	
FAILURE TO CYCLE		0	2		3		1	

Table 3 Velocity/Energy Summary

BOLT SET NO. 1 FT CARSON BFA NO. 1A 0° F TEMPERATURE

		M33 Ball LC-L-1-116	T40 Blank LC-L-95903	% of M33
V1 Velocity	$\bar{X}$	112	97	
(Initial)	σ	6	6	
V2 Velocity	$\bar{X}$	215	204	
(Post Unlocked)	σ	15	13	
E1 Energy	$\bar{X}$	566	428	
(Initial)	σ	56	54	
E2 Energy	$\bar{X}$	270	243	90%
(Post Unlocked)	σ	38	32	
Firing Rate	$\bar{X}$	499	474	
TOTAL ROUNDS FIRED		25	25	
FAILURE TO REACH BUFFER		0	0	
FAILURE TO CYCLE		0	0	

Table 4 Velocity/Energy Summary

BOLT SET NO. 2 FT BENNING BFA NO. 2A 0° F TEMPERATURE

		M33 Ball LC-L-1-116	T40 Blank LC-L-95903	% of M33
V1 Velocity	$\bar{X}$	111	78	
(Initial)	σ	5	3	
V2 Velocity	$\bar{X}$	211	149	
(Post Unlocked)	σ	32	18	
E1 Energy	$\bar{X}$	551	257	
(Initial)	σ	54	3	
E2 Energy	$\bar{X}$	241	131	54%
(Post Unlocked)	σ	44	32	
Firing Rate	$\bar{X}$	465	No rate available	
TOTAL ROUNDS FIRED		25		
FAILURE TO REACH BUFFER		0		
FAILURE TO CYCLE		0		

Table 5 Velocity/Energy Summary

BOLT SET NO. 1 FT CARSON BFA NO. 2A 125° F TEMPERATURE

		M33 Ball LC-L-1-116	T40 Blank LC-L-95903	% of M33
V1 Velocity	$\bar{X}$	106	95	
(Initial)	σ	11	5	
V2 Velocity	$\bar{X}$	197	194	
(Post Unlocked)	σ	15	10	
E1 Energy	$\bar{X}$	513	402	
(Initial)	σ	111	39	
E2 Energy	$\bar{X}$	229	219	95%
(Post Unlocked)	σ	36	24	
Firing Rate	$\bar{X}$	462	425	
TOTAL ROUNDS FIRED		29	30	
FAILURE TO REACH BUFFER		1	1	
FAILURE TO CYCLE		1	0	

Table 6 Velocity/Energy Summary

BOLT SET NO. 2 FT BENNING BFA NO. 2A 125°F TEMPERATURE

		M33 Ball LC-L-1-116	T40 Blank LC-L-95903	% of M33
V1 Velocity	$\bar{X}$	107	86	
(Initial)	σ	5	4	
V2 Velocity	$\bar{X}$	199	169	
(Post Unlocked)	σ	15	15	
E1 Energy	$\bar{X}$	511	335	
(Initial)	σ	51	31	
E2 Energy	$\bar{X}$	232	168	72%
(Post Unlocked)	σ	35	30	
Firing Rate	$\bar{X}$	455	390	
TOTAL ROUNDS FIRED		30	6	
FAILURE TO REACH BUFFER		0	3	
FAILURE TO CYCLE		0	3	

SUMMARY OF RESULTS

SECTION II

SUMMARY OF ENDURANCE FIRING RECORDS

ENDURANCE FIRING RECORD:
FT. CARSON BLANK FIRING ATTACHMENT
1B USING T40 BLANK LOT NUMBER LC-L-95903
TABLE 7

Rds on Blank Firing Attachment	No. of Underpowered Rds	Remarks
1-330	8	Chamber cleaned
331-660	4	Chamber cleaned
661-990	3	Chamber cleaned
991-1320	0	
1321-1650	0	Chamber cleaned
1651-1980	3	
1981-2310	0	
2311-2640	0	
2641-2970	0	
2971-3300	0	
3301-3630	10	
3631-3960	2	
3961-4290	13	
4291-4620	17	
4621-4950	28	
4951-5280	13	
5281-5610	22	
5611-5940	27	
5941-6270	11	
6271-6600	2	
6601-6980	0	
6931-7260	1	
7261-7590	0	

TABLE 7 Cont.

Rds on Blank Firing Attachment	No. of Underpowered Rds	Remarks
7591-7920	0	
7921-8250	330	Weapon operated manually- short recoil barrel & barrel extension changed
8251-8580	15	
8581-8910	12	
8911-9240	3	
9241-9570	14	
9571-9900	117	Muzzle cap bulged

ENDURANCE FIRING RECORD:
FT. BENNING BLANK FIRING ATTACHMENT
2B USING M1 BLANK LOT NUMBER TW-L-18052
TABLE 8

Rds on Blank Firing Attachment	No of Underpowered Rds	Remarks
1-330	14	
331-660	9	Chamber cleaned
661-990	8	Chamber cleaned
991-1320	7	Chamber cleaned
1321-1650	7	
1651-1980	8	Chamber cleaned
1981-2310	10	
2311-2640	0	
2641-2970	10	
2971-3300	4	
3301-3630	5	
3631-3960	15	Loose propellant in chamber Chamber cleaned
3961-4290	44	Loose propellant in chamber Chamber cleaned
4291-4530	53	Loose propellant in chamber-Chamber cleaned. Propellant flash in receiver. Firing terminated per SARRI-LS-C

BARREL DIAMETER MEASUREMENTS:
M2HB CAL. .50 MACHINEGUN BLANK FIRING
ATTACHMENT TEST
TABLE 9

*Barrel Diameter, inches	No. of Rds Fired	Remarks
1.501 x 1.501	0	Initial Measurement
1.499 x 1.500	100	Low Temperature test ($0^{O}F$)
1.497 x 1.498	158	
1.500 x 1.502	258	High temperature test ($125^{O}F$)
1.497 x 1.501	316	
1.498 x 1.500	426	Ambient temperature test ($70^{O}F$)
1.498 x 1.499	537	
1.497 x 1.497	586	
1.492 x 1.502	2766	Functioning & endurance test
1.496 x 1.498	4746	
1.496 x 1.498	6751	
1.495 x 1.493	8731	
1.489 x 1.493	11,281	
1.488 x 1.489	13,261	

*Measurements shown were taken in the vertical and horizontal planes, respectively, at approximately 0.5 inches from face of muzzle

SUMMARY OF RESULTS

SECTION III

SUMMARY OF AVAILABLE ENERGY TRANSFERRED

AFTER UNLOCKING

ENERGY TRANSFER EFFICIENCY

Rationale: The firing cycle of the M2HB Caliber .50 Machine Gun starts with firing of the round in the chamber. Recoil and muzzle booster action then cause the barrel, barrel extension and bolt assembly to move toward the rear reaching a velocity, V_1. After traveling a short distance to the rear, the bolt assembly is unlocked and released from the barrel extension and barrel. At about this point, the mechanical accelerator is engaged. The action of the accelerator stops the motion of the barrel and barrel extension and increases the velocity of the bolt assembly to a maximum, V_2. The kinetic energy of the bolt assembly moves the bolt further to the rear, thereby compressing the drive spring and storing energy with which to complete the firing cycle.

1. The kinetic energy of the bolt assembly at maximum recoil velocity, V_2, is a measure of the ability of the weapon mechanism to complete its firing cycle.

2. The kinetic energy of the combined barrel, barrel extension and bolt assembly at velocity V_1, is a measure of the ability of the blank firing attachment to impart energy into the weapon mechanism.

3. The efficiency with which energy given up by the barrel and barrel extenstion is transferred through the accelerator to the bolt assembly is a measure of accelerator performance and an indicator of the existance of excessive loads on the breech lock and/or the accelerator.

The Energy Transfer Efficiency, E_{EB}, is calculated from Time-Displacement data as follows:

$$E_{EB} = \frac{\text{ENERGY GAINED BY BOLT}}{\text{ENERGY LOST BY BARREL AND EXTENSION}} \times 100$$

$$E_{EB} = \frac{\dfrac{4.5 \times V_2^2 - V_1^2}{386.4 \times 2}}{\dfrac{30.4 \times V_1^2 - V_o^2}{386.4 \times 2}} \times 100$$

$$E_{EB} = \frac{14.8 \times V_2^2 - V_1^2}{V_1^2}$$

TABLE 10 ENERGY TRANSFER EFFICIENCY %

AMMO LOT NO	M33 BALL LC-L-I-116	T40 BLANK LC-L-95903	MI BLANK LC-L-12035	MI BLANK TW 18052
Ft CARSON				
AMBIENT	38.6	44.4	45.5	46.9
0°F	39.7	50.7		
125°F	36.3	46.9		
FT BENNING				
AMBIENT	37.4	42.3	41.9	45.9
0°F	38.7	39.2		
125°F	36.4	42.4		

ANALYSIS OF RESULTS

Both the Ft. Carson and Ft. Benning BFA are of the muzzle booster type; thus, this evaluation is limited to examining the performance of the M2HB Machine Gun Caliber .50 when powered by the muzzle booster type BFA.

Analysis of Ft. Carson time-displacement recordings reveal:

1. The Ft. Carson BFA firing blank ammunition from Lot Nos LC-L-95903 and LC-L-12035 generated bolt velocities and energies representative of those generated by firing M33 Ball ammunition.

2. The Ft. Carson BFA was severely overpowered (42% average excess) with blank ammunition from Lot No. TW 18052.

Based on the above analysis, and inspection of the physical condition of the available ammunition, Lot No LC-L-95903 was selected over LC-L-12035 to conduct the scheduled endurance test of 9900 rounds.

Analysis of Ft. Benning BFA time-displacement records revealed that the weapon was:

1. Underpowered with blank ammunition Lot Nos LC-L-95903 and LC-L-12035.

2. Significantly overpowered (20% average excess) with blank ammunition Lot No TW-18052.

An attempt was made to conduct an endurance firing test of 9900 rounds using the TW-18052 ammunition. This test was abandoned after 4530 rounds when it became apparent that due to the erratic ignition characteristics of the TW-18052 blank ammunition, it was not possible to maintain sustained firing long enough to explore heat disbursing capacity of the muzzle booster in a manner that could be compared with tests of the Ft. Carson BFA for evaluation of barrel muzzle errosion. Furthermore, there were substantial quantities of unburned powder which accumulated in the receiver and periodically flashed causing concern for the gunner's safety.

Inspection of the barrel and muzzle booster revealed that serious errosion and heat checking of the muzzle could be expected after 6,000 to 8,000 rounds had been fired and that prolonged firing caused the muzzle booster to bulge from the effects of the heat and pressure. From this, the following conclusions are drawn:

1. In their present form both BFA designs lack sufficient heat dispersion capability for safe firing of prolonged bursts.

2. Some means for preventing barrel muzzle errosion and heat checking is required especially if the weapon is to be used for accurate firing of ball ammunition on short notice without replacing the barrel.

Periodic inspection of the bolt, lock block and accelerator disclosed no excessive wear on these components. This fact coupled with data taken from time-displacement records was taken to indicate that a muzzle booster type BFA with matched blank ammunition could be expected to operate the weapon without unusual wear or damage to the mechanism for well in excess of 10,000 rounds, but that the muzzle of the barrel will be critically erroded and damaged.

Both the Ft. Carson and the Ft. Benning BFA blow gas and fine solid particles back into the gunner's face to varying degrees depending on clearance between the barrel and muzzle booster bore and the number of rounds fired since the BFA was cleaned. The gunners received no mark nor discernable injury from the gas or solid particles but the impact was distracting, uncomfortable, and poses a potential hazard.

CONCLUSIONS

The following conclusions can be drawn from this program:

1. Use of the Ft.Benning and Ft Carson BFA's can result in serious heat checking and erosion of the barrel muzzle. Parts wear does not exceed that caused by firing the M33 Ball ammunition if the blank ammunition is suitably matched to the BFA.

2. The Ft Carson BFA, when used with blank ammunition from Lot No TW-18052, severely overpowers (over 42%) the weapon mechanism to the detriment of the weapon life and safety.

3. The Ft Benning BFA, when used with blank ammunition from Lot No TW-18052, significantly overpowers (over 20%) the weapon mechanism and most probably reduces weapon life.

4. Both the Ft Benning and Ft Carson BFA's lack adequate heat dissipation capacity to safely sustain prolonged firing.

5. The present BFA designs permit excessive amounts of gas and combustion particles to be blown into the gunner's face.

6. The integral discriminator/mounting feature of the Ft Carson's BFA:

a. Effectively prevents accidental feeding of ball and tracer ammunition.

b. Provides good support and alignment for the muzzle cyclinder of the BFA.

c. Can provide minimal interference with weapon mounting/installations.

7. The eccentric support to the muzzle cylinder on the Ft Benning BFA causes pronounced flexing and whipping of the restraining rods which could lead to early fatigue failure.

8. The performance of existing ammunition varies so much both between lots and within lots that a new round must be developed in conjunction with BFA development to create a weapon/BFA/ammunition system whose performance will meet all training requirements with consistancy and safety.

RECOMMENDATIONS

1. Future development of a "muzzle booster" type blank firing attachment (BFA) should:

   a. Improve heat dissipation of the muzzle cylinder.
   b. Protect the barrel muzzle from heat checking, wear and erosion.
   c. Improve safety factors under all operating conditions.
   d. Eliminate gas and particle leakage in the direction of the gunner.

2. Alternative concepts to the "muzzle booster" type BFA should be designed and tested, especially "floating chamber" devices.

3. Special attention should be given to development of BFA concepts which promote:

   a. Accurate control of the volume of gas under pressure.
   b. Accurate control of pressure release timing at all temperatures.
   c. Adequate safety factors for all components especially those parts subject to heat and pressure during firing.
   d. Maximum protection from safety hazards arising from accumulations of unburned powder.
   e. Maximum protection from safety hazards arising from "hang-fire" rounds.
   f. Maximum protection from accidental loading and firing of a ball round.

4. A common round of caliber..50 blank ammunition should be developed for use with all caliber .50 BFA.

5. New blank ammunition should be manufactured to exacting tolerances and specifications to assure consistant reliable performance.

6. The caliber .50 blank round shall have approximately the same profile as a ball round and be capable of "push through" stripping and feeding as well as "pull-push" feeding common to the M2HB weapon.

7. All BFA designs shall operate their specific weapons so that the dynamics of the weapon mechanism when firing a common blank round will approximately equal but not exceed dynamic values generated when firing standard ball ammunition.

8. Development of a BFA/Ammunition system for the M2HB and the M85 Machine Guns should be conducted simultaneously in accordance with the program and schedule discussed on the following page and detailed in Appendix A.

RECOMMENDED DEVELOPMENT PROGRAM

Objective: The Recommended Development Program will develop a single round of blank caliber .50 ammunition and two separate Blank Firing Attachments (BFA), one specifically designed for use on the M2HB Machine Gun and the other BFA specifically designed for use on the M85 Machine Gun.

Technical Approach: The Recommended Technical Approach is to conduct a coordinated program of simultaneous development to produce the BFA's and the ammunition in accordance with the development plan entitled "Blank Firing Attachments (BFA) and Blank Ammunition Product Improvement Program for M2HB Caliber .50 Machine Guns Using a Common Round of Blank Ammunition" and the accompanying schedule and events shown in the appendix.

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APPENDIX A

RECOMMENDED DEVELOPMENT PROGRAM

BLANK FIRING ATTACHMENTS (BFA) AND BLANK AMMUNITION
PRODUCT IMPROVEMENT PROGRAM FOR M2HB AND M85 CALIBER .50 MACHINE GUNS
USING A COMMON ROUND OF BLANK AMMUNITION

Appropriation: Ammunition and Training Device.

System/End Item: Caliber .50 Blank Firing Attachment and Ammunition for use with M2HB and M85 Machine Guns.

Reference:

Type and No. - Final Draft Letter Requirement
Date - 30 May 1975
Authority - PM, TRADE

Description/Justification:

Currently there is no widely available BFA for the M2 Heavy Barrel Caliber .50 Machine Gun nor for the M85 Caliber .50 Machine Gun. Neither is there a current Caliber .50 blank round of ammunition. There is in existence a small quantity of caliber .50 blank ammunition which was loaded about 1942. Most of this ammunition is in poor condition and the rest is judged unserviceable (Code E). Components for this ammunition are unavailable and obsolete and the design is inadequate for reliable performance, especially in the M85 Machine Gun. Thus there is no way to simulate the firing of these weapons in the field training environment. As a result, two of the primary anti-personnel/anti-light vehicle/anti-air weapons cannot be employed in tactical training. Given the requirement to use the weapons in engagement simulation systems such as REALTRAIN and MILES, a WESS is urgently required to provide a signature from the position of the firing weapon; the BFA will serve as that WESS for the caliber .50 machine guns. As part of the Marksmanship Laser System, the BFA will contribute to significant annual savings in real estate required for range firing.

Engineering Status:

1. BFA's for the M2HB weapon have been built and used with success in training at Ft. Benning and Ft. Knox. Earlier efforts in Canada and at TACOM, Warren, Michigan, with similarly designed BFA's have apparently been at least partially successful although no documentation of these test results has been located. Also since these BFA's were tested with the existing old, obsolete ammunition the performance may not be representative of the results to be obtained with newly prepared ammunition.

2. BFA's for both M85 and M2HB are available in Europe from Dynamite-Nobel. These devices require a special, full profile, blank round which is produced and sold by Dynamite-Nobel. Performance characteristics of these BFA's are unknown.

3. Preliminary investigations of M2HB and M85 mechanism dynamics indicate that the M85 requires approximately 65% more energy than the M2HB to cycle the weapon and that the probability of product improving the BFA for the M85 is very low unless product improvement of ammunition is undertaken simultaneously.

4. Given that BFA's are to be made readily available for both M2HB and M85 weapons and that a common blank round of ammunition is to be used in both weapons, it may be concluded from item 3 above that an improved round of ammunition must be based on the energy requirements of the M85 mechanism. Once the improved round of ammunition and BFA are available for the M85 it appears that improvement of the BFA for the M2HB can be based on the existing Ft. Benning units.

5. The most critical problem in improving these BFA's will be to insure through analysis and testing that sufficient energy is transferred to the weapon mechanism for reliable function without risking damage or excessive wear in the weapon mechanism caused by overstressing the various components.

6. An equally critical problem is caused by the requirement for the round to feed reliably through both the M2HB straight pull feed mechanism and the M85 push through feed system. At present it appears that the blank round will have to have a full profile configuration closely approximating the shape of the ball round.

Scope of Program:

RDT&E	FY 77	FY 78	FY 79	Total Prog
M85 BFA	126K	126K	20K	272K
M2HB BFA	126K	126K	20K	272K
Ammunition	See attached estimate of ammunition costs			
Total RDT&E (Less Ammunition)	252K	252K	40K	544K

Procurement:

Procurement costs cannot be estimated in detail until analysis of the weapon/ammunition interface is completed.

Procurement quantities will be commensurate with the Basis of Issue which includes:

a. One device for each three (3) caliber .50 machine guns, M85 and M2HB, authorized by TOE/MTOE plus 10% float authorization (envisioned CTA as an inclusion).

b. Additional BFA authorization for M85 and for M2HB:

40 each* - USAARMS	10 each - USAFAS
20 each - USAIS	5 each - ACC

* Each type weapon, i.e., 40 for M85 plus 40 for M2HB

Basis for Cost Estimates:

Based on $40,000 per man year.

a. M85 BFA Product Improvement (PI):

Team Leader	3/4 man year	$30,000
Analyst	1/4 man year	$10,000
Mechanical Engr	1 man year	$40,000
Engineering Tech*	1.5 man year	$52,500
(* $35,000 per man year)		
Total Direct Labor		$132,500

Task 1 - Initial Phase

(1) Analyze M85 mechanism to determine safe limits of impulse at end of barrel.

(2) Design improved Ft. Benning type blank firing attachment.

(3) Design improved blank round configuration suitable for M85 feeding.

(4) At FA, design improved blank round based on required impulse and configuration, (1) and (3) above.

(5) Fabricate BFA hardware, 5 units.

(6) At FA, initiate ammunition improvement.

(7) Test.

(8) Evaluate

Initial Phase Time and Cost (RIA):

Elapsed Time - 4½ months

RIA Direct Labor - $5096.15 x 4.5	$22,932.68
Hardware, 5 BFA units - $1500 x 5	$ 7,500.00
Computer - $800 x 4.5	$ 3,600.00
Test Range - 20 days x $1000/day	$20,000.00
Total Initial Phase	$54,032.68

Task 2 - Secondary PI

(1) Design modified BFA.

(2) Fabricate modified BFA, 5 units.

(3) At FA, design modified blank ammunition.

(4) At FA, fabricate #1 sample lot of ammunition, 5,000 rounds with PI propellant.

(5) Test.

(6) Evaluate.

Secondary PI Phase Time and Cost (RIA):

Elapsed Time - 4½ months

RIA Direct Labor - $5096.15 x 4.5	$22,932.68
Hardware, 5 BFA units - $1500 x 5	$ 7,500.00
Computer - $800 x 4.5	$ 3,600.00
Test Range - 42 days x $1000/day	$42,000.00
Total Secondary PI Phase	$76,032.68

Task 3 - Final PI Phase

(1) Finalize BFA design

(2) Fabricate BFA's, 10 units

(3) At FA, Finalize ammunition design.

(4) At FA, fabricate #2 lot of ammunition, 62,000 rounds, PI round.

(5) Conduct safety acceptance test.

*(6) Conduct engineering test (ET).

*(7) Conduct operational test (OT).

(8) Evaluate.

(9) Type classify.

Final PI Phase Time and Cost (RIA):

Elapsed Time - 17 months	
RIA Direct Labor - $5096.15 x 17	$86,634.55
Hardware, 10 BFA units - $1500 x 10	$15,000.00
Computer - $800 x 17	$13,600.00
Safety/Acceptance Test - 18 days x $1000/day	$18,000.00
*Engineering Test, 180 day duration, 60 days support on site at Ft. Benning	$ 5,742.00
*Operational Test, 75 day duration, 25 days support on site at Ft. Benning	$ 2,392.50
Total Final PI Phase	$141,369.05
Total M85 BFA Product Improvement Program	$271,434.41

*PM-TRADE will provide all manpower, supervision, funding, and facilities to perform those tests to be conducted at Ft. Benning. SARRI-LS will provide on-site technical support as indicated.

b. M2HB BFA Product Improvement Program

Team Leader	3/4 man year	$30,000
Analyst	1/4 man year	$10,000
Mechanical Engr	1 man year	$40,000
Engineering Tech	1.5 man year	$52,500
Total Direct Labor		$132,500

Task 1 - Initial Phase

(1) Analyze M2HB mechanism to determine safe limits of impulse at end of barrel.

(2) Design muzzle cap tube blank firing attachment similar to Ft. Benning BFA to use ammunition being developed for M85 BFA.

(3) Fabricate BFA hardware, 5 units.

(4) Test.

(5) Evaluate.

Initial Phase Time and Cost (RIA):

Elapsed Time - 4½ months

RIA Direct Labor - $5096.15 x 4.5	$22,932.68
Hardware, 5 units - $1500 x 5	$ 7,500.00
Computer - $800 x 4.5	$ 3,600.00
Test Range - 20 days at $1000/day	$20,000.00
Total Initial Phase	$54,032.68

Task 2 - Secondary PI Phase

(1) Design modified BFA.

(2) Fabricate Modified BFA.

(3) Test.

(4) Evaluate.

Secondary PI Phase Time and Cost (RIA):

Elapsed Time 4½ months

RIA Direct Labor - $5096.15 x 4.5	$22,932.68
Hardware, 5 BFA units - $1500 x 5	$ 7,500.00
Computer - $800 x 4.5	$ 3,600.00
Test Range - 42 days x $1000/day	$42,000.00
Total Secondary PI Phase	$76,032.68

Task 3 - Final PI Phase

(1) Finalize BFA design.

(2) Fabricate BFA's, 10 units.

(3) Conduct Safety Acceptance Test.

*(4) Conduct Engineering Test (ET).

*(5) Conduct Operational Test (OT).

(6) Evaluate.

(7) Type classify.

Final PI Phase Time and Cost (RIA):

Elapsed time - 17 months

RIA Direct Labor - $5096.15 x 17	$86,634.55
Hardware, 10 BFA units - $1500 x 10	$15,000.00
Computer - $800 x 17	$13,600.00
Safety/Acceptance Test - 18 days x $1000/day	$18,000.00
*Engineering Test - 18 days duration, 60 days support on site at Ft. Benning	$ 5,742.00
*Operational Test, 75 days duration, 25 days support on site at Ft. Benning	$ 2,392.50
Total Final PI Phase	$141,369.05
Total M2HB BFA Development Program	$271,434.41

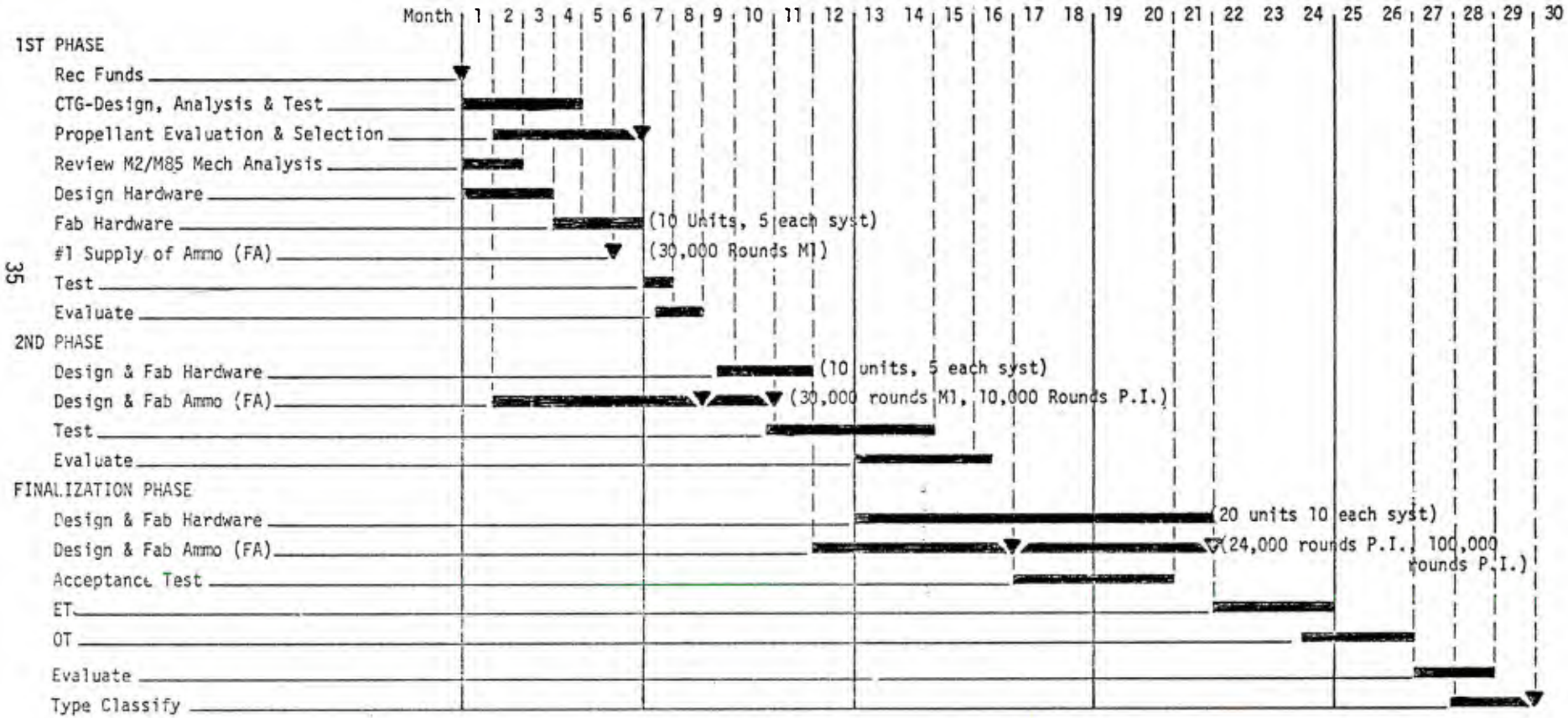
*PM-TRADE will provide all manpower, supervision, funding, and facilities to perform these tests to be conducted at Ft. Benning. SARRI-LS will provide on-site technical support as indicated.

c. Caliber .50 Blank Ammunition Product Improvement Program

Task 1 - The Caliber .50 Blank Ammunition will be Product Improved at Frankford Arsenal to meet the requirements for a common round of blank ammunition for use in both the M85 and M2HB Machine Guns. A detailed breakdown of Time and Cost, prepared and validated at Frankford Arsenal, is attached.

SCHEDULE FOR PRODUCT IMPROVEMENT OF BLANK FIRING ATTACHMENT FOR CALIBER .50 MACHINE GUN

*NOTE: Schedule is for Cal .50 BFA Product Improvement. Assuming a common rd of ammo is used on both M85 and M2HB, both wpns can be addressed concurrently on the shown schedule. Product Improvement of the ammo will be done concurrently at FA.



APPENDIX B
PHOTOGRAPHS

FIGURE	
1	TEST SET-UP FORT CARSON BFA
II	FORT CARSON BFA MOUNTED ON M2HB
III	TEST SET-UP FORT BENNING BFA
IV	FORT BENNING BFA MOUNTED ON M2HB
V	BULGED MUZZLE CYCLINDER, FT CARSON BFA, 9900 ROUNDS
VI	BARREL MUZZLE ERROSION AFTER 8731 ROUNDS
VII	BARREL MUZZLE ERROSION AFTER 8731 ROUNDS
VIII	BARREL MUZZLE ERROSION AFTER 11,281 ROUNDS
IX	BARREL MUZZLE ERROSION AFTER 11,281 ROUNDS
X	BARREL MUZZLE ERROSION AFTER 13,261 ROUNDS
XI	PRESSURE TEST SET-UP FORT CARSON BFA
XII	PRESSURE TEST SET-UP FORT BENNING BFA

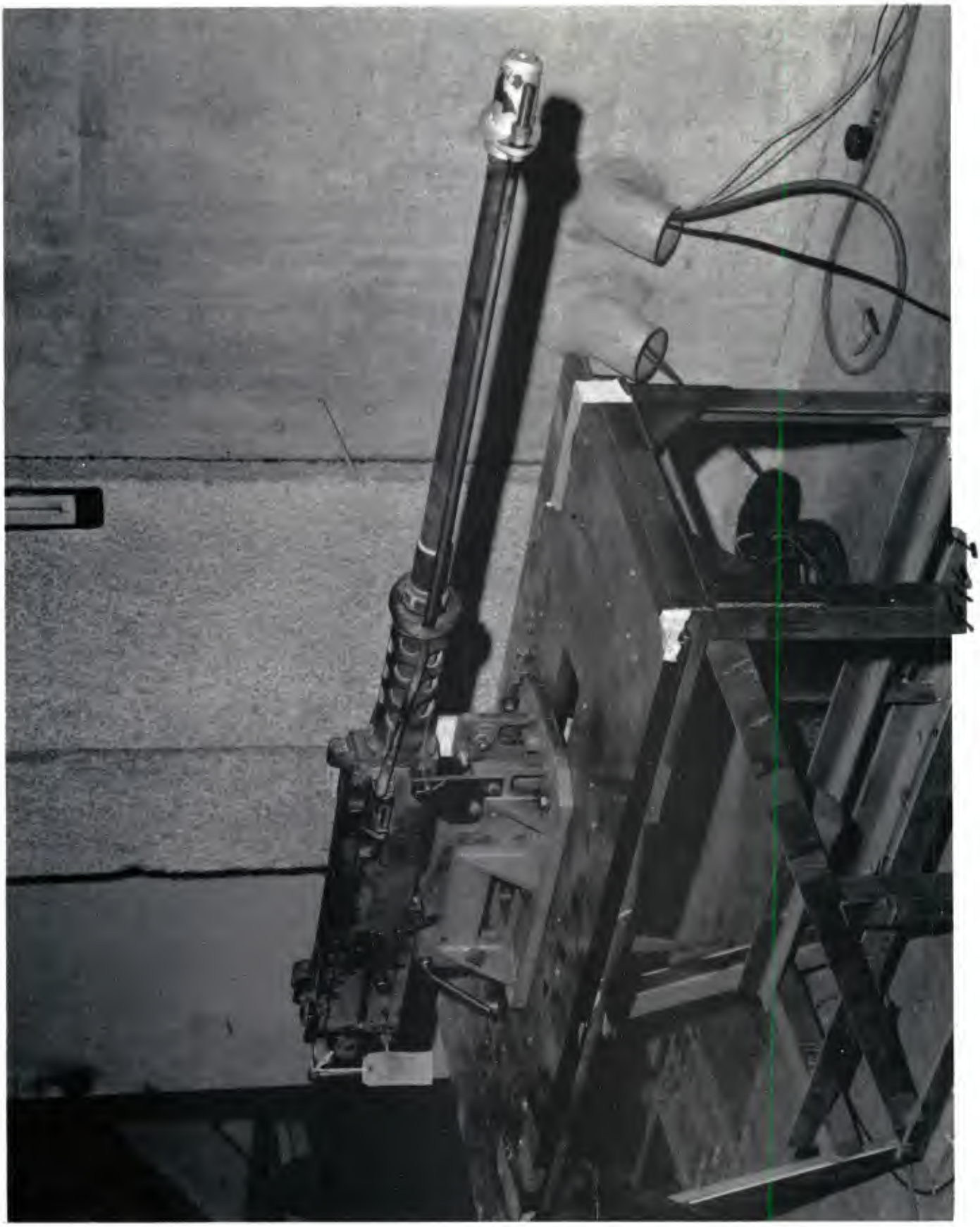


FIG. 11

Fig. 24

FIG. 11

FIG. 17

FIG 17

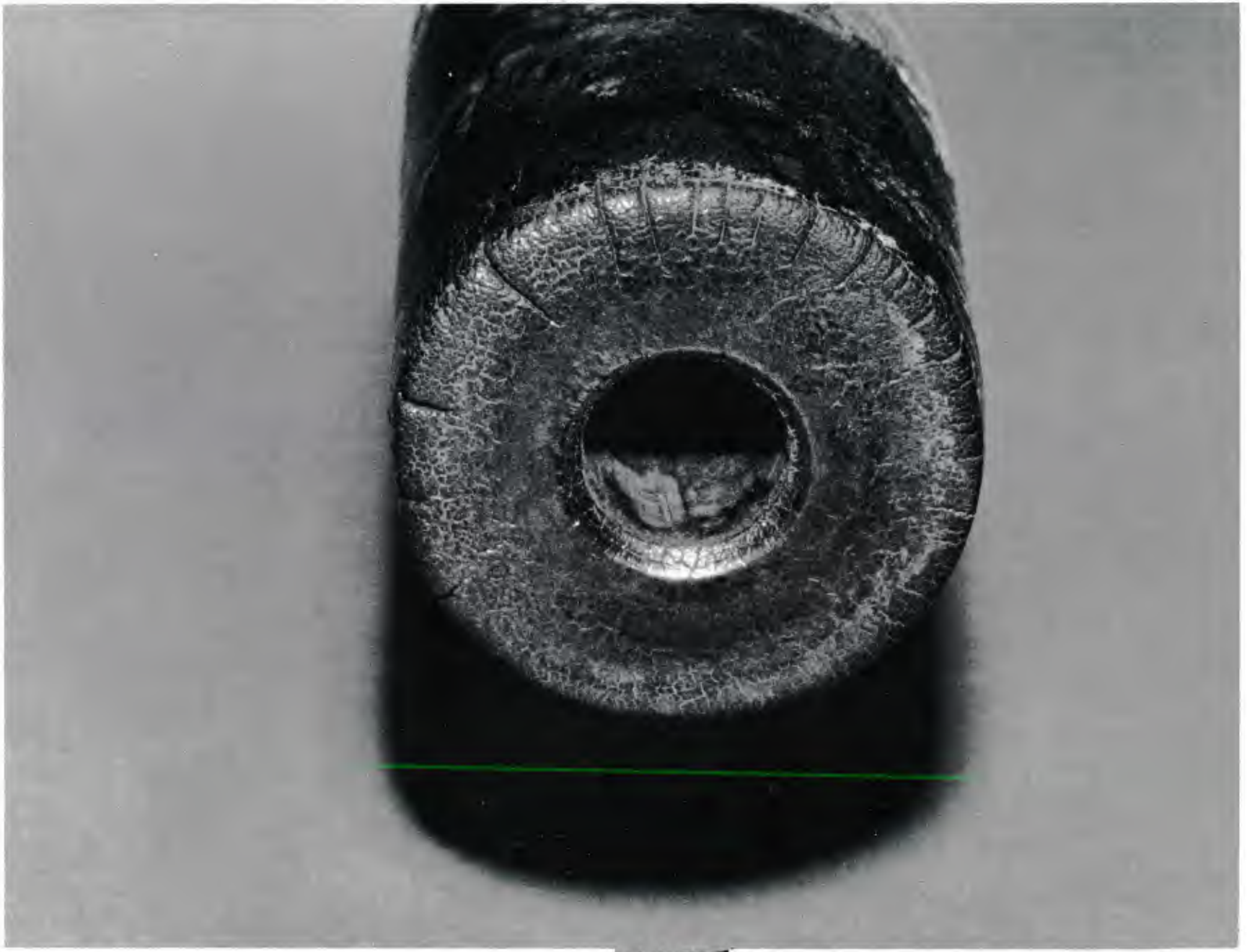


FIG VII

Fig. VIII

Fig. 9A

FIG. I

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GTX

APPENDIX C

INSPECTION REPORTS FOR BOLT SETS

FIGURE 11 ACCELERATOR

12 BOLT

13 LOCK

ACCELERATOR
RECORDED INSPECTION AREAS

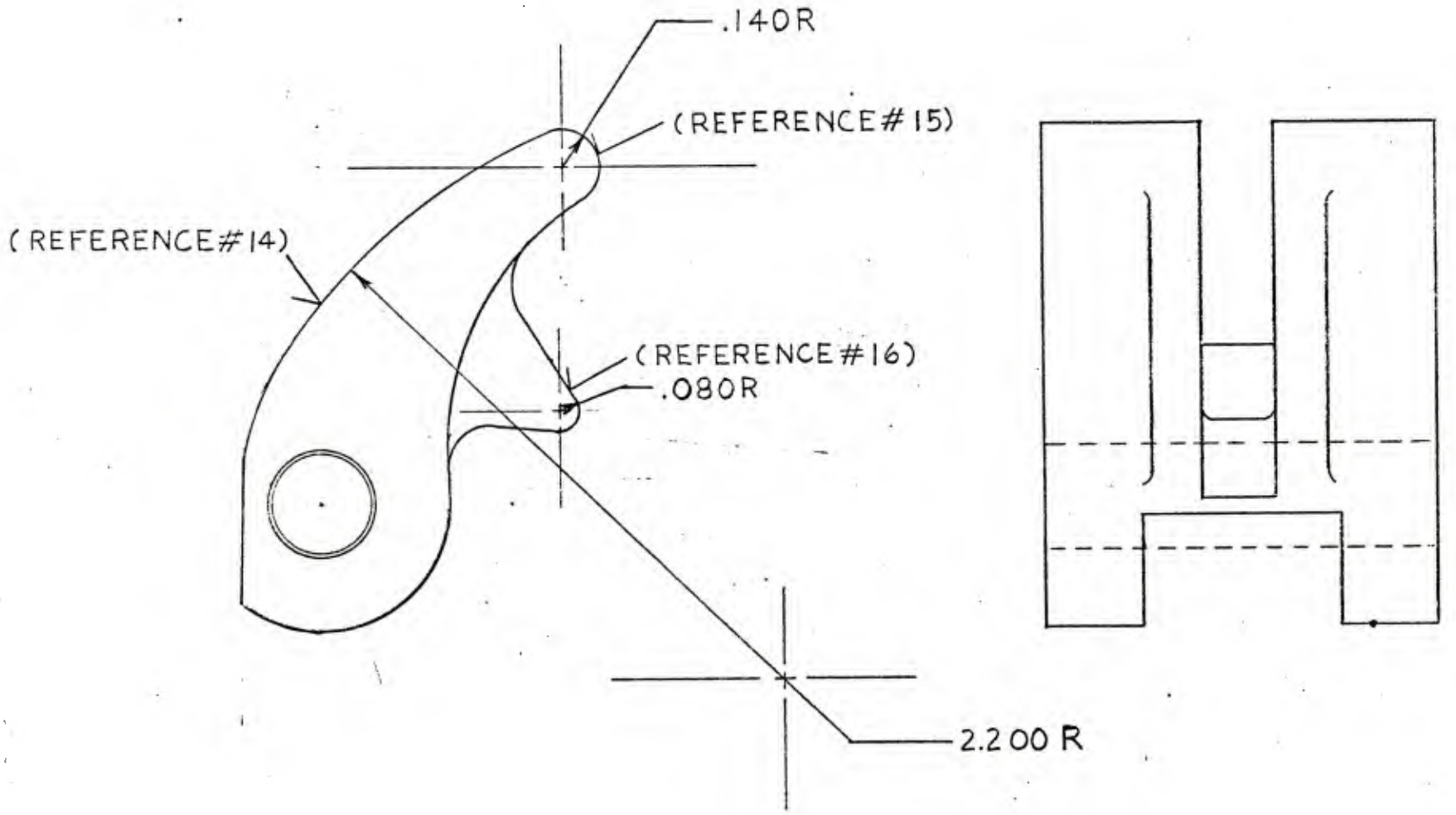

FIGURE 11

BOLT, ALTERNATE FEED
RECORDED INSPECTION AREAS

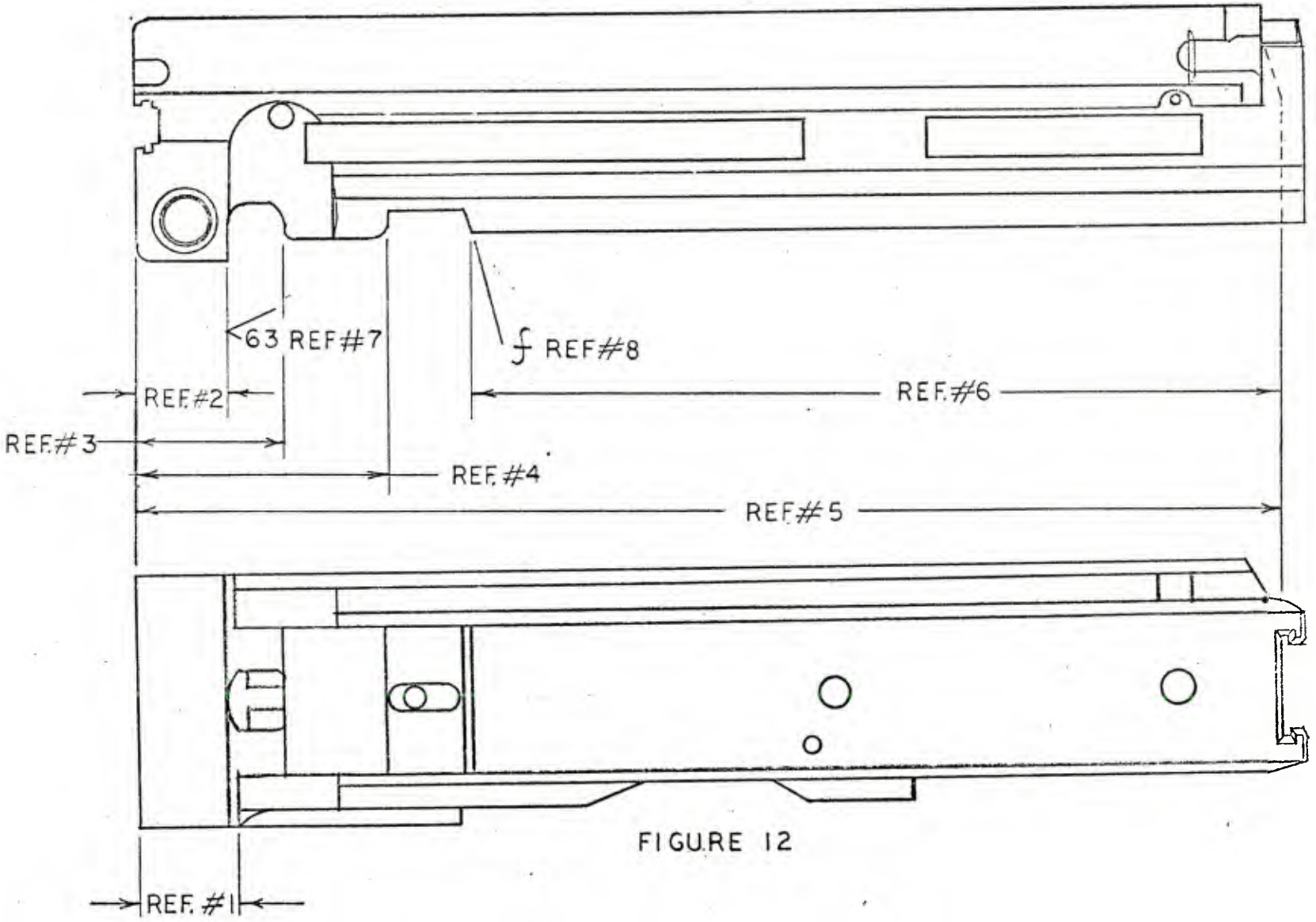

FIGURE 12

LOCK, BREECH
RECORDED INSPECTION AREA

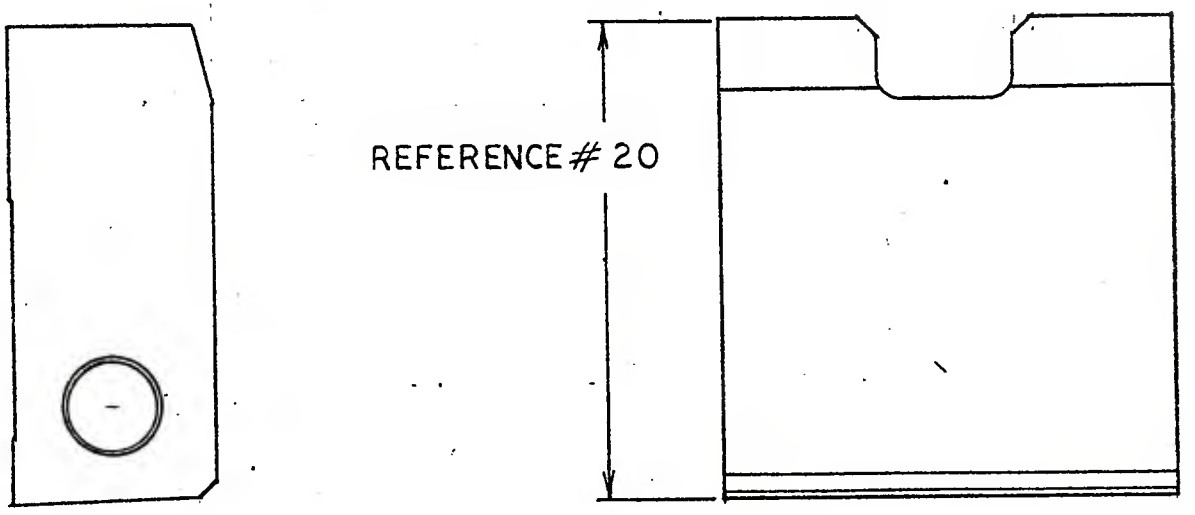

FIGURE 13

52

INSPECTION REPORT NO 1

Bolt, Alternate Feed DWG. # 6528256

INITIAL MEASUREMENTS

		#1	#2
1	.75 +.06	.747	.748
2	.725 -.010	.723 - .727	.727
3	1.147 +.010	1.158	1.158 - 1.159
4	1.95 - .01	1.954 - 1.953	1.9115
5	8.905 -.005	8.905	8.9011
6	6.307 -.005	6.302	6.305
7	63 Finish	20 - 30	20 - 30
8	~~F~~	20-30 (worn)	20-30 (worn)
9	.752 - .005	.747	.748
10			
11			
12	ACCELERATOR,	DWG#	5508141
13		#1	#2
14	2.200 R.	13-18	8-10
15	.110 R.	20 - 15	12-15
16	.080 R	10	12
17			
18	Lock, Breech	DWG	7161302
19		#1	#2
20	1.467 - .005	1.475 TO 1.445	1.475 TO 1.444
21			
22		Insp	9 Dec 75
23			R. Fricke
24			
25			

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INITIAL MEASUREMENTS

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INSPECTION REPORT NO 2

AFTER HIGH & LOW TEMPERATURE TESTS

BOLT, ALTERNATE FEED — DRG. F6528256

		#1	#2
1	.75 +.06	.747	.748
2	.725 -.010	.724 - .727	.726
3	1.147 +.010	1.158	1.157
4	1.95 -.01	1.953 -1.954	1.946 - 1.945
5	8.905 -.005	8.904	8.904
6	6.307 -.005	6.302	6.303
7	63 FINISH	15 - 30	20 - 30
8	F	20 - 30 (WORN)	20 - 30 (WORN)
9	.752 -.005	.747	.748
10			

ACCELERATOR — DRG. D5508141

		#1	#2
13			
14	2.200R	15 - 25	8 - 12
15	.140R	20 - 25	15 - 20
16	.080R	15	15

LOCK, BREECH — DRG. C7161302

		#1	#2
19			
20	1.467 -.005	1.473 TO 1.446	1.472 TO 1.443
21			
22			
23		INSPECTED 9FEB 76	
24			Keith E. Wurie

Rediform 4S 476 AFTER LOW & HIGH TEMPERATURE TESTS

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INSPECTION REPORT NO 3
AFTER 990 RDS ENDURANCE TEST

BOLT, ALTERNATE FEED — DRG. F6528256

		#1	#2
1	.75 +.06	.747	.748
2	.725 -.010	.724 - .727	.727
3	1.147 +.010	1.158	1.157
4	1.95 -.01	1.953 - 1.954	1.943 - 1.945
5	8.905 -.005	8.904	8.904
6	6.307 -.005	6.302	6.304
7	63 FINISH	15 - 30	20 - 35
8	5	15 - 25 (WORN)	20 - 35 (WORN)
9	.752 -.005	.747	.748
10			

ACCELERATOR — DRG. D5508141

		#1	#2
13			
14	2.200R	15 - 30	10 - 15
15	.140 R	15 - 25	15 - 25
16	.080R	15 - 20	15 - 20

LOCK, BREECH — DRG. C7161302

		#1	#2
19			
20	1.467 -.005	1.475 TO 1.445	1.474 TO 1.443
21			
22		INSPECTED 23FEB76	
23			Fleish E Wise
24			

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#4

INSPECTION REPORT NO 4

AFTER 1980 RDS ENDURANCE TEST

BOLT, ALTERNATE FEED — DRG. F6528256

		#1	#2
1	.75 +.06	.747	.748
2	.725 -.010	.723 TO .727	.726 TO .727
3	1.147 +.010	1.158	1.156 TO 1.158
4	1.95 -.01	1.953 TO 1.954	1.943 TO 1.945
5	8.905 -.005	8.903	8.904
6	6.307 -.005	6.302	6.303
7	63 FINISH	15 - 30	20 - 30
8	5	15 - 20 (WORN)	20 - 30 (WORN)
9	.752 -.005	.746 TO .747	.747 TO .748
10			

ACCELERATOR — DRG. D5508141

		#1	#2
13			
14	2.200R	15 - 20	10 - 15
15	.140R	20 - 25	15 - 25
16	.080R	15 - 20	15 - 20

LOCK, BREECH — DRG. C7161302

		#1	#2
19			
20	1.467 -.005	1.475 TO 1.4425	1.474 TO 1.442
21			
22			INSPECTED 1 APR 76
23			Keith E Wise
24			

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1980 RDS ENDURANCE

#5

INSPECTION REPORT NO 5
AFTER 3960 RDS ENDURANCE TEST

BOLT, ALTERNATE FEED — DRG. F6528256

		#1	#2
1	.75 + .06	.747	.748
2	.725 - .010	.723 TO .727	.725 TO .726
3	1.147 + .010	1.158 TO 1.159	1.157 TO 1.159
4	1.95 - .010	1.953 TO 1.954	1.942 TO 1.9445
5	8.905 - .005	8.903 TO 8.905	8.904
6	6.307 - .005	6.302	6.303
7	63 FINISH	15 - 35	15 - 30
8	F	15 - 30 (WORN)	15 - 30 (WORN)
9	.752 - .005	.746 TO .747	.747 TO .748
10			

ACCELERATOR — DRG. D5508141

		#1	#2
13			
14	2.200 R	15-25	10 - 15
15	.140 R	20-30	15-30
16	.080 R	15-20	15-20

LOCK, BREECH — DRG. C7161302

		#1	#2
19			
20	1.467 - .005	1.475 TO 1.442	1.474 TO 1.442
21			
22			
23		INSPECTED	19 APR. 76
24			D. Eggins

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3960 RDS ENDURANCE

#6

INSPECTION REPORT NO 6
AFTER 4530 RDS ENDURANCE TEST ON BOLT SET 2
AFTER 5940 RDS ENDURANCE TEST ON BOLT SET 1

BOLT, ALTERNATE FEED — DRG. F6528256

		#1	#2
1	.75 +.06	.747	.748
2	.725 -.010	.723 TO .727	.725 TO .726
3	1.147 +.010	1.158 TO 1.159	1.157 TO 1.158
4	1.95 -.01	1.952 TO 1.954	1.942 TO 1.945
5	8.905 -.005	8.903 TO 8.905	8.903 TO 8.904
6	6.307 -.005	6.302	6.302
7	63 FINISH	15 - 30	15 - 30
8	F	15 - 30 (WORN)	15 - 30 (WORN)
9	.752 -.005	.745 TO .747	.747 TO .748
10			

ACCELERATOR — DRG. D5508141

	#1	#2
2.200R	15 - 25	10 - 15
.140R	20 - 30	15 - 30
.080R	15 - 25	15 - 20

LOCK, BREECH — DRG. C7161302

	#1	#2
1.467 -.005	1.475 TO 1.442	1.474 TO 1.441

INSPECTED 26 MAY 76
Keith E. Wise

4530 RDS ENDURANCE ON BOLT SET 2
5940 " " " " " 1

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4S 476

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#7

INSPECTION REPORT NO 7

FINAL MEASUREMENT BOLT SET # 1

BOLT, ALTERNATE FEED — DRG. F 6528256

		#1	
1	.75 +.06	.747	
2	.725 -.010	.727 TO .723	
3	1.147 +.010	1.159 TO 1.158	
4	1.95 -.01	1.954 TO 1.953	
5	8.905 -.005	8.905 TO 8.903	
6	6.307 -.005	6.302	
7	63 FINISH	15-25	
8	F	15-30 (WORN)	
9	.752 -.005	.744 TO .748	
10			

11

12 ACCELERATOR — DRG. D 5508141

		#1	
13			
14	2.200 R	15-20	
15	.140 R	20-30	
16	.080 R	15-20	

17

18 LOCK, BREECH — DRG. C 7161302

		#1	
19			
20	1.467 -.005	1.475 TO 1.443	

21

22

23 INSPECTED 17 JUN 76

24 Keith E. Wise

25

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FINAL MEASUREMENTS

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APPENDIX D

AMMUNITION PERFORMANCE
AND
SELECTION

60

ENDURANCE TEST AMMUNITION PERFORMANCE AND SELECTION RATIONALE

The following three lots of blank ammunition were available in quantity for evaluating weapon life versus the Ft. Benning and Ft. Carson blank firing attachments (BFA).

1. Lot No. TW-L-18052

2. Lot No. LC-L-12035

3. Lot No. LC-L-95903

Endurance testing ammunition was selected from these lots on the basis of evaluation of time-displacement records.

Lot No. TW-L-18052 was selected for endurance testing with the Ft. Benning BFA. Time-displacement records indicated this was the only lot capable of functioning the M2HB Machine Gun with the Ft. Benning BFA at energy levels great enough to significantly affect weapon life. Unfortunately as the test progressed the performance of the remaining ammunition in this lot deteriorated drastically and the test had to be stopped after 4530 rounds of the scheduled 9900 rounds had been fired. Subsequent pressure-time readings taken in the muzzle cylinder using samples of remaining ammunition indicated poor combustion and very low pressure being developed. This can only be attributed to advanced ammunition deterioration. It was noted that the ammunition boxes were not vapor sealed and there was extensive evidence of moisture intrusion and damage. The muzzle flame was observed to have a yellow color.

Ammunition Lot No LC-L-12035 was not vapor sealed but appeared to be relatively free from moisture damage. Both pressure tests and time displacement tests indicated fairly consistant performance but time displacement records showed energy levels considerably below the M33 ball round when using the Ft Benning BFA. Time displacement records indicated a good match to the M33 ball energy using the Ft Carson BFA. However, Lot No LC-L-95903 promised more consistant performance, as well as a satisfactory energy match and thus, was selected for endurance testing with the Ft Carson BFA.

Lot No LC-L-95903 was vapor packed and promised the most consistant performance of the three lots of ammunition. As stated above, it was, therefore, selected for endurance testing with the Ft Carson BFA. Unfortunately, time-displacement tests indicated that energy levels with the Ft Benning BFA were only about 70 - 75 percent of the M33 Ball round energy. While the weapon operated fairly consistantly at this low energy

level, the reduced velocities and accellerations negated the value of an endurance test conducted with this ammunition. The muzzle flame had a brilliant white color.

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MUZZLE CYLINDER PRESSURES

Blank Firing Attachment — Ft Benning

Ammunition: Lot No. LC-L-12035			
Shot No.	Peak Pressure	Pulse Duration (Sec)	BFA No.
1	3450	.032	2C
2	4250	.032	2C
3	3200	.030	2C
4	3820	.033	2C
Average	3680		
Maximum	4250		
Minimum	3200		
Range	1050		
Ammunition: Lot No. TW-L-18052			
5	2800	.040	2C
6	450	.022	2C
7	2370	.039	2C
8	2450	.040	2C
9	2350	.038	2C
10	2170	.036	2C
11	1630	.044	2C
12	1590	.044	2C
Average	1976		
Maximum	2800		
Minimum	450		
Range	2350		
Ammunition: Lot No. LC-L-12035			
13	3700	.040	2C
Ammunition: T40 Lot No LC-L-95903			
1	5180	.025	2C
2	7050	.024	2C
3	5200	.023	2C
4	9300	.027	2C
5	9400	.025	2C
6	8600	.026	2C
Average	7455		
Maximum	9400		
Minimum	5180		
Range	4220		

MUZZLE CYLINDER PRESSURES

Blank Firing Attachment — Ft Carson

Shot No.	Peak Pressure	Pulse Duration (Sec)	BFA No.
Ammunition: Lot No. LC-L-12035			
13A	3530	.042	1A
14	4310	.040	1A
15	7500	.041	1A
16	5000	.042	1A
17	5590	.042	1A
18	5000	.035	1A
Average	5155		
Maximum	7500		
Minimum	3530		
Range	3970		
Ammunition: Lot No. TW-L-18052			
19	6400	.040	1A
20	6350	.040	1A
21	6580	.042	1A
22	5600	.046	1A
23	7590	.050	1A
24	5030	.060	1A
25	6250	.036	1A
26	8120	.042	1A
27	5200	.040	1A
Average	6347		
Maximum	8120		
Minimum	5030		
Range	3090		
Ammunition: T40 Lot No. LC-L-95903			
1	5190	.032	1A
2	8200	.032	1A
3	8100	.026	1A
4	8450	.030	1A
5	8375	.030	1A
Average	7663		
Maximum	8450		
Minimum	5190		
Range	3260		

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Small Arms Weapon Systems Directorate
GEN Thomas J. Rodman Lab, Rock Island Arsenal
EVALUATION OF TWO BLANK FIRING ATTACHMENTS
FOR THE M2HB CALIBER .50 MACHINE GUN by
Roy F. Schwegler

Rodman Laboratory Report R-TR-76-022 -/
June 1976
66 pages, Including Tables & Figures
Unclassified Report

Firing tests were conducted using an M2HB Caliber .50 Machine Gun equipped with blank firing attachments (BFA) fabricated at Ft. Benning and Ft. Carson. Two BFA of each design were tested. Both designs operate on the muzzle booster principle. Three lots of blank ammunition were tested and one lot of M33 ball ammunition was fired to provide a base line for comparison of weapon mechanism performance. All of the existing blank ammunition including those lots tested were loaded in 1943-44 or in 1953. Because of its age and the way it was packed and

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1. BFA
2. Blank Firing Attachment
3. Cal .50 Blank Firing Attach.
4. M2HB MG
5. Weapon Emission Simulator System
6. Wess
7. Muzzle Erosion

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